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AGRICULTURAL VENTILATING AND HEATING CONTROLS

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INTRODUCTION

New and greatly improved controls are now available. These controls provide steady room temperatures, last longer, are energy efficient and many have potential to control multiple fans and heaters with one sensor and thermostat. Typically, room temperature is the controlled factor. However, humidity, dust and gas levels (ammonia, carbon dioxide etc.) can also be controlled.

Figures 1 shows typical thermostatic controllers being used in many livestock and poultry barns.

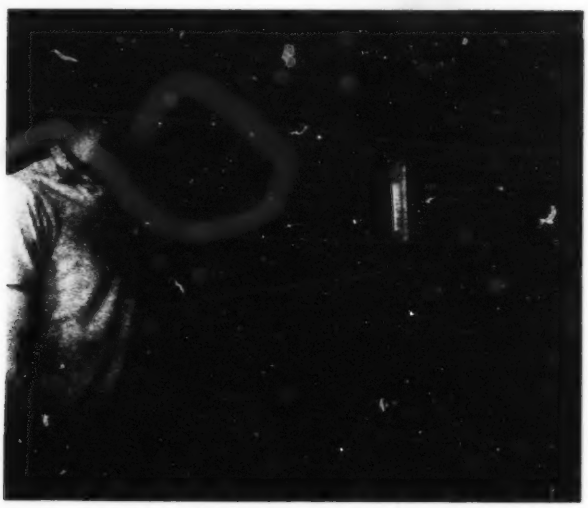

Figure 1 Multiple thermostats for a hot nursery. Note the maximum-minimum thermometer for calibrating thermostats and determining room temperature fluctuations.

AVAILABLE TEMPERATURE CONTROLS

1. Traditional Controls

Most current controllers use gas or liquid filled coils or tubes as their sensors (Figure 2). As the temperature near these coils changes, this gas or liquid expands (room heating up) or

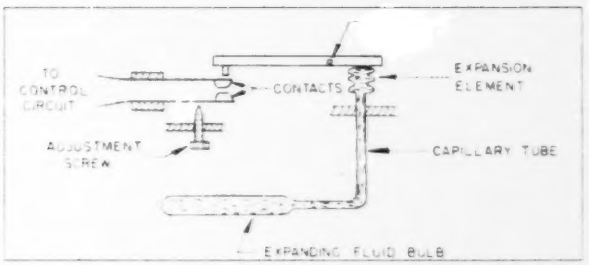

Figure 2 Operation of a typical line voltage thermostat. As room temperature rises, the fluid expands, causing the contacts to close and an electrical circuit to be made. Temperature drops result in opened contacts and the electrical circuit is opened or "broken".

contracts (room cooling down) causing contacts to open or close. This then turns the fan or heater off or on. These controllers are inexpensive and relatively reliable.

However, they corrode quickly in harsh environments and tend to wander off calibration, resulting mainly in temperature fluctuations that waste energy and affect animal health.

Bimetallic strip thermostats are also in common use, particularly in residential homes, but are extremely vulnerable to corrosion. Hence, they are not recommended for agricultural applications.

For multiple fan systems, multiple thermostats are required to provided sequential staging increasing the likelihood of poor temperature control.

2. Heater Interlock Controls

When using standard thermostats for fan control while adding supplemental heat, the potential exists for concurrent high level fan and heater operation. This wastes heating energy and does little to maintain steady temperatures. To avoid this, two steps are required:

(a) Purchase a thermostat to operate the heater and locate it adjacent to the fan control sensor, away from the air path of the heater. Typical internal heater thermostats measure temperature inside the heater, not the room temperature which it is attempting to control.

(b) Install a relay on the stage 2 (moisture level) ventilation fan, such that when this fan activates due to warmer room temperatures, the relay automatically cuts off power to the heater. This ensures that simultaneous heater and upper level ventilation cannot occur. Refer to Canada Plan Service #9701 for more details and wiring diagrams.

3. Electronic Variable Speed Controls with Remote Sensors

Several electronic controls are available for control of variable single, and 2 speed fans as well as heaters (Figure 3). Electronic means that the control uses only electrical components and sensors, as opposed to typical thermostats (described earlier) which use mechanical components for switching.

Most electronic sensors work on the basis that their electrical resistance changes proportionately to the room temperature. This resistance is "read" by the controller. For instance, a variable speed controller would work as follows: if the resistance varies from the temperature set point resistance, the controller will vary voltage to the fan, speeding it up for warmer temperatures (sensor indicates higher resistance) and slowing it down for cooler temperatures (sensor indicates lower resistance).

Energy savings from variable speed fans running at low speeds are small. In most fans used today, power requirements do not change significantly regardless of fan speed.

Also, not all variable speed controllers work on all fans. Before purchasing, ensure that the fan to be controlled will work with the controller.

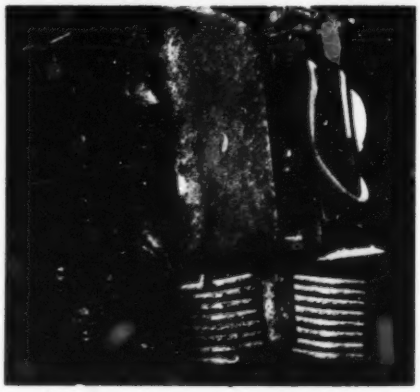

Figure 4 An electronic sensor on the left compared to a typical fluid-filled electro-mechanical thermostat sensor.

4. Sequential Controls

More recently, single unit controls are available for agriculture that control all levels of heating and ventilating. The main feature of these controllers is very close (within 1.5°C) of room set point temperature control, low maintenance, long life and high energy efficiency. They are, however, relatively expensive to install.

Figure 5 shows one such unit. Qualified electricians and/or technicians familiar with electronic equipment will be required to install, start up and maintain these controllers.

Figure 3 Electronic variable speed thermostats employing remote temperature sensors. Note the large easily read temperature scale on the Honeywell Modufan. The Alpha has an easy to read digital display.

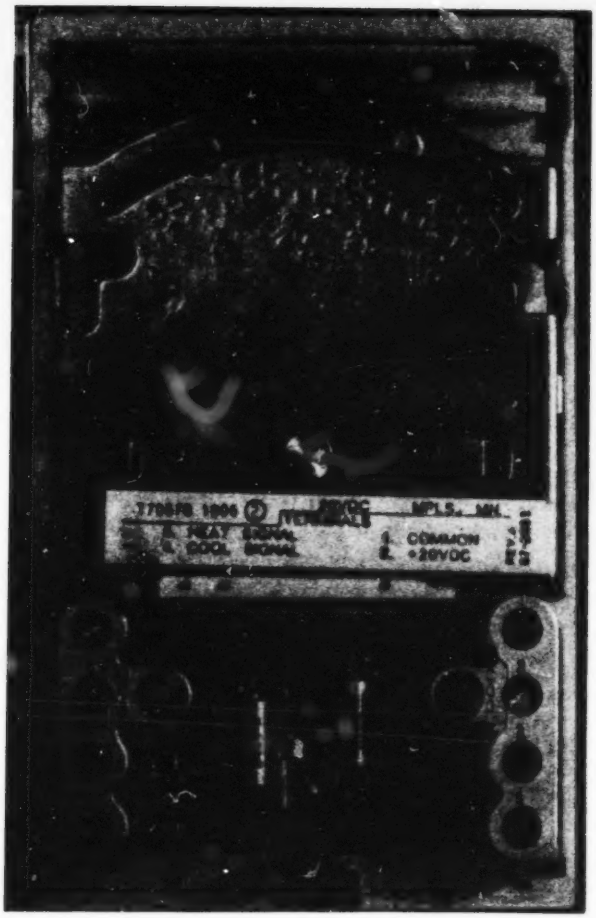

Figure 5 The Honeywell W973 sequential thermostatic control. The W973 and the Alpha BC-01 (not shown) are two examples of controllers which can sequence multiple levels of ventilation and heating equipment, all from one sensor.

5. Computer Controls

Computer control is exactly what its' name implies; it uses a microcomputer such as the IBM PC™ (Personal Computer) to control heating, ventilation and air inlet equipment. These are powerful machines, capable of controlling multiple rooms in many barns. Odour and air quality control can also be achieved by sensors which measure room relative humidity and gas levels such as ammonia, carbon dioxide, etc.

Multiple uses are also possible at the same time as control is occurring (called multi-tasking). These other uses include monitoring and recording of feed and water consumption, alarms indicating security breeches, temperature and water pressure high/low limits exceeded, etc.

Currently, costs of these systems are very high, starting at $15,000. Anyone considering such a unit should weigh the on-farm installation cost and serviceability against benefits provided. However, costs have been decreasing and on-farm service is becoming more readily available as rural electricians develop expertise with these units.

One major disadvantage is that microcomputer failure results in the entire control system stopping, akin to "putting all ones' eggs in one basket". However, the use of "smart boards", located adjacent to each room being controlled eliminates this risk. A smart board receives temperature and other control related instructions from the microcomputer. Once these instructions are stored in the smart board, it independently controls and monitors the room as required. This eliminates the danger of farm control shut down because of one piece of equipment failing. The microcomputer is then basically used to record data as required and to change room temperature and other settings.

LIGHT DIMMER SWITCHES

There are many variable level light an heat lamp dimmer switches available now. It is important to purchase energy efficient dimmers which cost the same as regular (resistive type) dimmers. Standard wattage 120 volt dimmers are 300, 500, 600, 1000 and 1500 W. A 2000 W, 120 V unit is also available, but will require heavier wiring and a larger fuse or breaker switch.

Three position diode dimmers are also popular, providing off/full power/half power settings. Refer to OMAF Factsheet *Saving Dollars With Heat Lamps and Dimmer Switches*, Agdex 440/717 Order No. 84-009 for further information.

MANUAL VARIABLE SPEED MOTOR CONTROLS

Manual variable speed motor controls are popular for air recirculation systems and ceiling recirculation fans. Other applications include using them on minimum ventilation fans where livestock densities vary (i.e. all-in, all-out weaner nurseries). Care must be taken not to lower a fan speed to the point where air is no longer being exhausted.

Motor controls are readily available for 120 V motors up to 9 A. Motors requiring 220 V manual variable speed controls are not as readily available beyond 2.5 A (which should cover many agricultural applications) but can be purchased.

Be sure to used variable dimmer switches designed for motor control. Other switches may work, but will not last as long and will invalidate manufacturers' warranties.

CONCLUSIONS

Control of the environment is a critical aspect of livestock and poultry production. More sophisticated, accurate and reliable controls are continually being developed. For further information, consult your local county agricultural engineer.

™ IBM PC is a trade mark of International Business Machines

TABLE 1. EXAMPLES OF CONTROLS

Type	Cost (Uninstalled)	Controller Locations	Sensor Types	Temp. Control Accuracy	Comments
ELECTROMECHANICAL THERMOSTATS					
Honeywell T631A Single Speed	$58	In Room	Fluid	Medium	– shortened life in corrosive environments
White Rogers Two Speed	$60	In Room	Fluid	Medium	– shortened life in corrosive environments
ELECTRONIC THERMOSTATS					
Alpha MC–01	$500	Hallway, etc.	Electronic	Good	– many features such as heater interlock, adjust. min. rate etc.
Honeywell Modufan T731	$	Hallway, etc.	Electronic	Good	– operate with or w/o low temp. cut-out
Ranco E-31	$150	Hallway, etc.	Electronic	Med-Good	- can adjust minimum level vent. rate
Phason	$150	In Room	Electronic	Good	– can adjust minimum level vent. rate
MULTI STAGE THERMOSTATS					
Alpha BC–01	$1000	Hallway, etc.	Electronic	Very Good	– up to 16 levels of vent., 1 level heat
Honeywell W973	$1000	Hallway, etc.	Electronic	Very Good	– up to 13 levels of vent. and/or heating
MICRO COMPUTER					
PMS–2000	$50000 +	Hallway, etc.	Electronic	Good	– complete control and monitoring system, typically marketed at $1/bird for broiler barns
Roth MBCS–9500	$15000	Office	Electronic	Very Good	– up to 15 rooms controlled from one unit for this price

NOTES:

1. Not all controls available have been listed.
2. All costs (September 1987) are estimates only for comparison purposes, actual costs may vary.

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